Telescopio Nazionale Galileo

HARPS-N Autoguide Manual

Manual version 1.2
TNG-MAN-HARPN-0004
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V1.2	22/03/2021	2.5 and 2.6.2.2.1	New version of Web GUI

Contents

1 Introduction

1.1 Scope

This User Manual is intended to give all necessary information to potential users of the HARPS-N instrument, to help them to use the instrument and manages the observation at the TNG telescope.

The following documents are closely related to this manual and should be consulted as well:

- The HARPS-N Startup Manual (TNG-MAN-HARPN-0001)
- The HARPS-N User Manual (TNG-MAN-HARPN-0002)
- The HARPS-N Operation Guide (TNG-MAN-HARPN-0003)
- The New Short Term Scheduler User Manual (NSTS)
- The DRS User Manual (OG-MAN-HAN-13-0004)

Both are available through the TNG web page

http://www.tng.iac.es/instruments/harps/

1.2 Additional information

The latest information updates about the HARPS-N instrument can be found on the HARPS-N web pages

http://www.tng.iac.es/instruments/harps/

1.3 Contact information

Feedback on this User Manual from users is encouraged. Please email to cosentino@tng.iac.es

1.4 Reference documents

[RD01] HARPS-N User Manual

[RD02] HARPS-N Quick Start Guide

[RD03] HARPS-N Operational Guide

[RD04] HARPS-N LCU Manual

[RD05] New Short Term Scheduler User Manual (NSTS)

[RD06] DRS User Manual

[RD07] Ucam User manual

[RD08] Templates Reference Guide

[RD09] Thorium-Argon Atlas

[RD10] Design of the LCU for HARPS-N

2   The New HARPS-N autoguide

The new autoguide has been developed by a team made up by personnel of University of Geneva, of Trieste Observatory and of TNG.

The autoguide (AG) system is made up by two parts:

1. The CORE (new AG CORE) that is executed in the AG computer (nag = 161.72.92.27, user = hanmgr, password = 'the standard harpsn password')

2. The WEB-GUI, that is launched in a Chrome browser (different browsers are not fully compatible)

The new HARPS-N autoguider system include some changes in the sequencer and in the LCU

system that will be described in detail in the other HARPS-N manuals.

2.1   Autoguide Operating Mode

To use the autoguide in a proper way the user has to follow the instructions described below.

2.4.1   Start the autoguide

1. Start the AG core as described in the paragraph 2.5
2. Make sure that the "AG core" starts in a correct way, checking that the terminal shows the line**:: - AG Core Ready !** at the end of the log
3. Open the WEB GUI in a Chrome browser as described in paragraph 2.6

2.4.2   Stop the autoguide

1. Make sure that the AG camera is NOT acquiring images; if yes stop the acquisition before of all.
2. Go into the "AG core" terminal and do CTRL+C
3. Make sure that the "AG core" ends in a correct way, checking that the terminal shows the line: **Exit AG Core. Bye !** at the end of the log

    The WEB GUI will show the message of Figure 2 at the end of the operations.

2.5   The AG Core

The AG core manages the communication with the autoguide system (camera, tip tilt), with the telescope control system (TCS) and with the sequencer.

The first operation is the execution of the AG core from the nag machine. This operation can be done by a ssh connection from any machine of the control room or by click in the **CORE** icon in the **wsoper** machine (Figure 1).
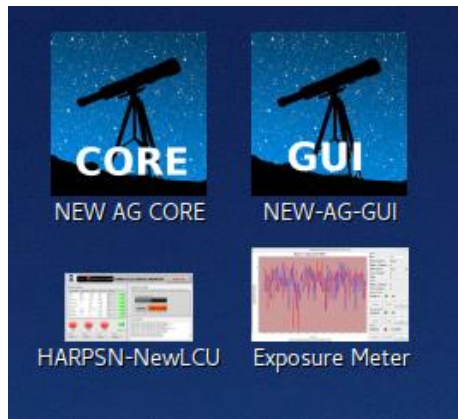
Figure 1 - wsoper machine: Icons to start the HARPSN features

After the connection the following operations can be done:

Start of the AG core → ag

Stop of the AG core → CTRL+C (to close all the connection properly)

At the end of observation, the AG-CORE mast be closed with CTRL+C

VERY IMPORTANT NOTES:

- **NOT EXIT the Core software while the camera is taking images**
- **If the ag crashes abruptly, execute the command: ./copia.sh from the ag terminal and start again the ag, waiting few seconds.**

2.6 The WEB GUI (start and operation)

2.6.1 Start the WEB GUI

The WEB-GUI starts a connection with the AG core, it has to be started after the AG core. In case of the AG core was down the browser will show an error message (Figure 2).
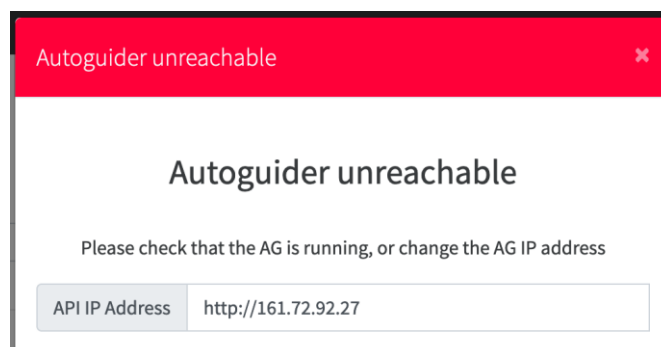

Figure 2 - Autoguider Unreachable message

To launch the WEB-GUI click on the GUI icon in the wsoper machine (Figure 1) and enter with the TO user (Figure 3). For advanced operation there is available the EN account.

Figure 3 - WEB GUI login

After the introduction of the credentials the web interface will start.

2.6.2 The WEB GUI panels

The HARPSN-AG WEB GUI consists in the following panels:

1. **TCCD engineering**, available only for the EN user
2. **Field stabilization**
3. **Stabilization status**
4. **Algorithm parameters**, available only for the EN user
5. **Console**
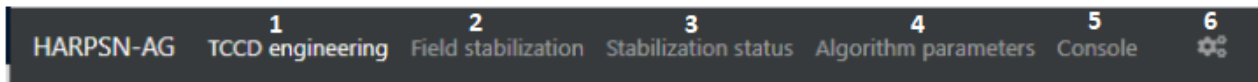6. **Configuration** (on the right of the black top band)

Figure 4 - WEB GUI Panels (no guiding)

The colour of the bar give the information about the state of the guiding:

- Grey → no guiding (wait state)
- Green → is guiding without errors
- Red → some error occurred

Figure 5 - WEB GUI Bar (guiding without errors)

Figure 6 - WEB GUI Bar (errors in guiding)

2.6.2.1 TCCD Engineering

This panel is available only for the EN user and has to be used only for engineering operations.

In this paragraph, I do not explain in details all the features of this panel because most of them are very specific and not useful in normal scientific observations. Despite this, some operations can be used in some cases (to be agreed with the HARPSN scientist).

- Start centroid → enable/disable the centroid calculation

- Start integrate image → enable/disable the integrate image (used for the reference position calculation)
- Piezo movements (in pixels) → move the piezo

More operations will be described in the next version of this manual, if needed.
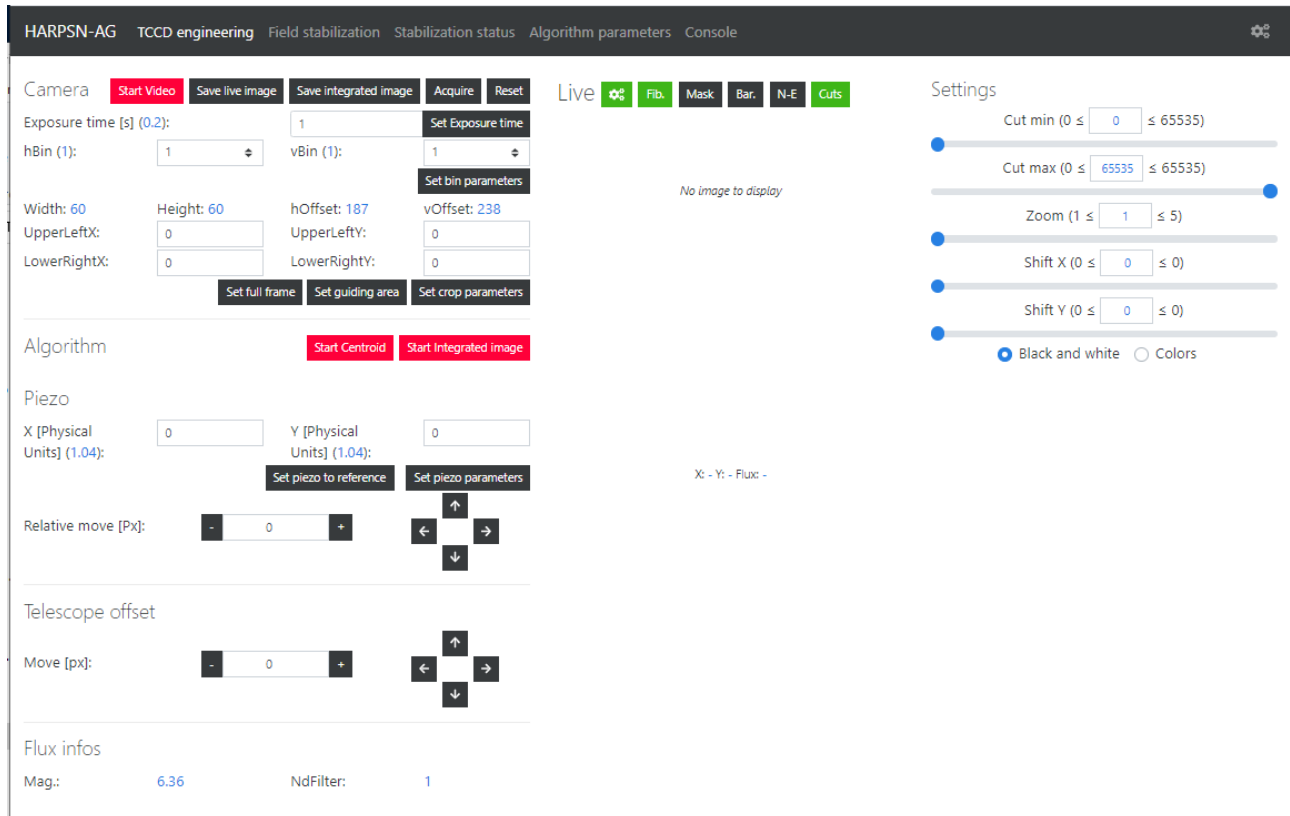

Figure 7 - The TCCD engineering panel

2.6.2.2 Field stabilization panel

This is the main panel, used by the operator during the scientific observation and during the focus procedure.

The panel is divided in three parts:

1. The interactive part, that include some button, arrows and field to set values or do actions.
2. The image display part, that show the camera image and the integrated image
3. The statistic part, which show the trend of the guide corrections and the associated errors.

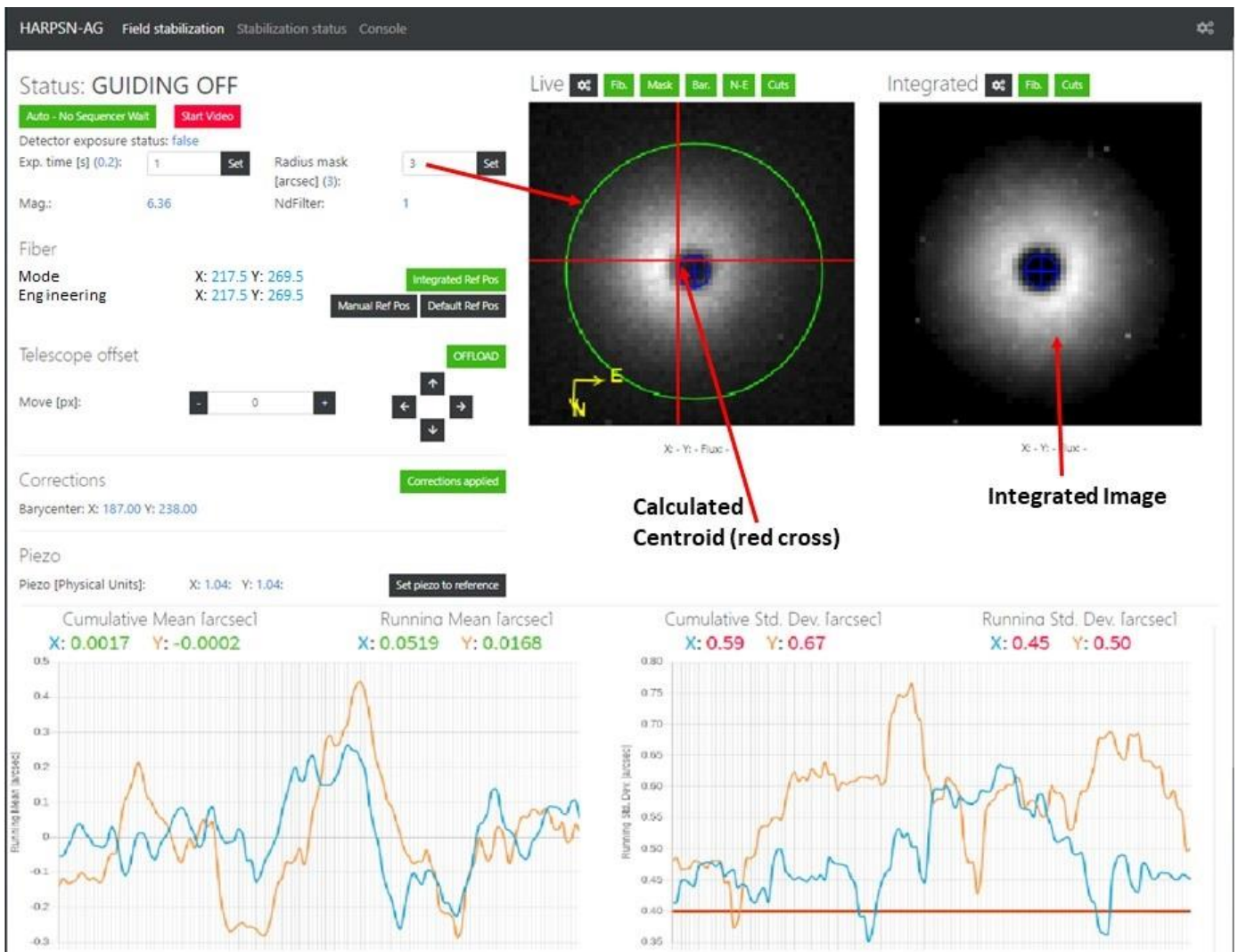The blue values in parentheses are the actual used values.

Figure 8 - Field stabilization panel

2.6.2.2.1 The interactive part

In the interactive part, the user can change some parameters of the autoguide, move the telescope and enable/disable some feature of the autoguide procedure by using buttons, arrows and introducing values in some fields.

Arrows

- Telescope Offset
  Moves the star (apparently) in the direction of the arrow, by a pixel number set in the interface.

Set values:

- **Exp.Time**
  The sequencer sets the exposure time automatically; depending by the brightness of the star, (a minimum exposure time is fixed). The user can modify this value by inserting the wanted exposure time and then click the set button.
- **Radius Mask**

The radius mask defines the area where the AG computes the centroid. The user can change this value by inserting the new value in the box and click on the set button.

- **Telescope Offset move (nr. Pixels)**
  The user can define the step (in pixels) of the telescope offset.
- **Ref. Position Values**
  See *the Reference position Buttons* paragraph

Buttons

- **Auto - No Sequencer Wait** / **Sequencer Waiting ...** button
  In 'auto- No Sequencer Wait' mode, the sequencer starts the scientific acquisition as soon as the autoguide is ready to work.
  In 'Sequencer Waiting ...' mode the sequencer remains in waiting until the state change to 'auto'
- **Start Video** / **Stop Video** button
  Start/stop the AG camera acquisitions
- **OFFLOAD** / **NO OFFLOAD** button
  Enable/disable the OFFLOAD (the offload is the offset, sent to the TCS, every fixed amount of time).
- **Corrections applied** / **correction skipped**
  Enable/Disable the correction
- **Reference position Buttons**
  This group of buttons define the position that the AG use as reference for the guiding. The "Engineering values" shows the position of the fiber in the image of the camera.
  - **Integrated Ref Pos**
    This is the default mode; the reference is calculated with the integrate image (Figure 9). The "Mode (auto)" shows the position used by the guide as fiber reference.
  - **Manual Ref Pos.**
  - If the user select this option, the position has to be inserted manually (Figure 10). The "Mode (manual)" shows the position used by the guide as fiber reference.
  - **Default Ref Pos** This option uses the default value of the fiber (Figure 11). The "Mode (manual)" shows the position used by the guide as fiber reference.
  After each changes, click on the **set** button to do the action effective.

- **Set piezo to reference button**
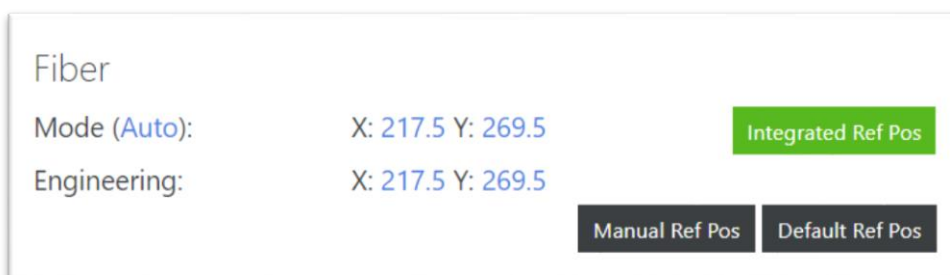 - Reset the position of the piezo to the default position.

Fiber

Mode (Auto):   X: 217.5 Y: 269.5   Integrated Ref Pos

Engineering: X: 217.5 Y: 269.5   Manual Ref Pos   Default Ref Pos

Figure 9 - Integrated Reference position (Default)

Figure 10 - Manual reference position

Figure 11 - Default reference position

2.6.2.2.2 The image display part

In this part are shown the **Live** and the **integrated** images. In the live images is shown the image acquired by the AG camera (the rate is defined in the configuration panel in Figure 17), the radius mask (green circle), the position of the calculated centroid (Red Cross) and the reference position (blue circle).

The integrated image is the sum of several images, and is used for the calculation of the reference point where the autoguide center the star (the integration start every time that the Exp.Time is changed by the user).

On the top of each visualized image, there are several buttons (Figure 12):

- ⚙ → open the 'Cuts' and Visualization Options on the visualized image (Figure 13)
- Fib. → toggle the visualization of the fiber circle
- Mask → toggle the visualization of the mask circle
- Bar. → toggle the visualization of the centroid bar
- N-E → toggle the visualization of the compass
- Cuts → toggle the visualization of the visualization options
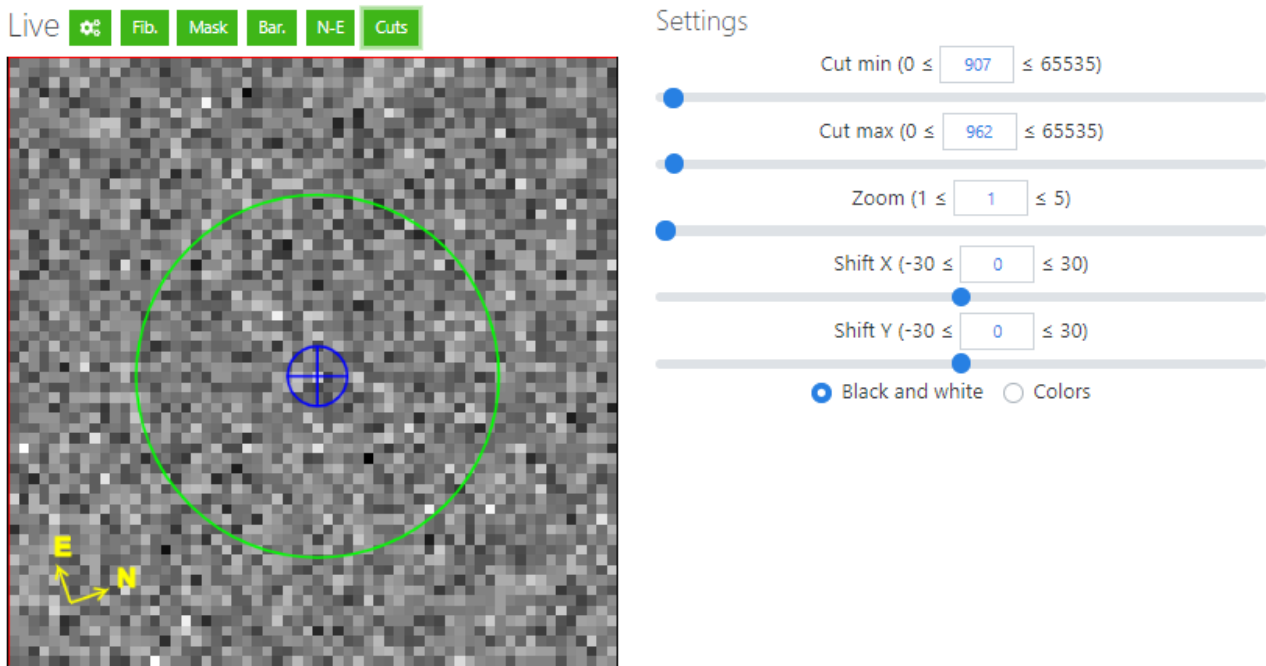

Figure 12 - Image display settings

Figure 13 - Visualization Options on the visualized image

2.6.2.2.3 The statistic part

On the bottom of the panel (Figure 8) are visualized two graphs and some numerical information.
The graphs show the trend of the corrections applied (in arc seconds) while the numerical information are the corresponding numerical value. On the left side is shown the mean, while on the right side the standard deviation. The color of these numbers give the information about the guide quality: Green means that the quality of the guide is good and red means that is poor.

2.6.2.3 Stabilization status panel

This panel give some information about the status of the guiding:

- Centroid algorithm
  Show the status (active/no active) and the occurrence of errors[*]
- Integrated algorithm
- Show the status (active/no active) and the occurrence of errors[*]
- Quality (instantaneous)
- Quality (Integrated)
- Piezo position
  Show the piezo position

For each entry, there is a description of the meaning of the information shown (Figure 14).

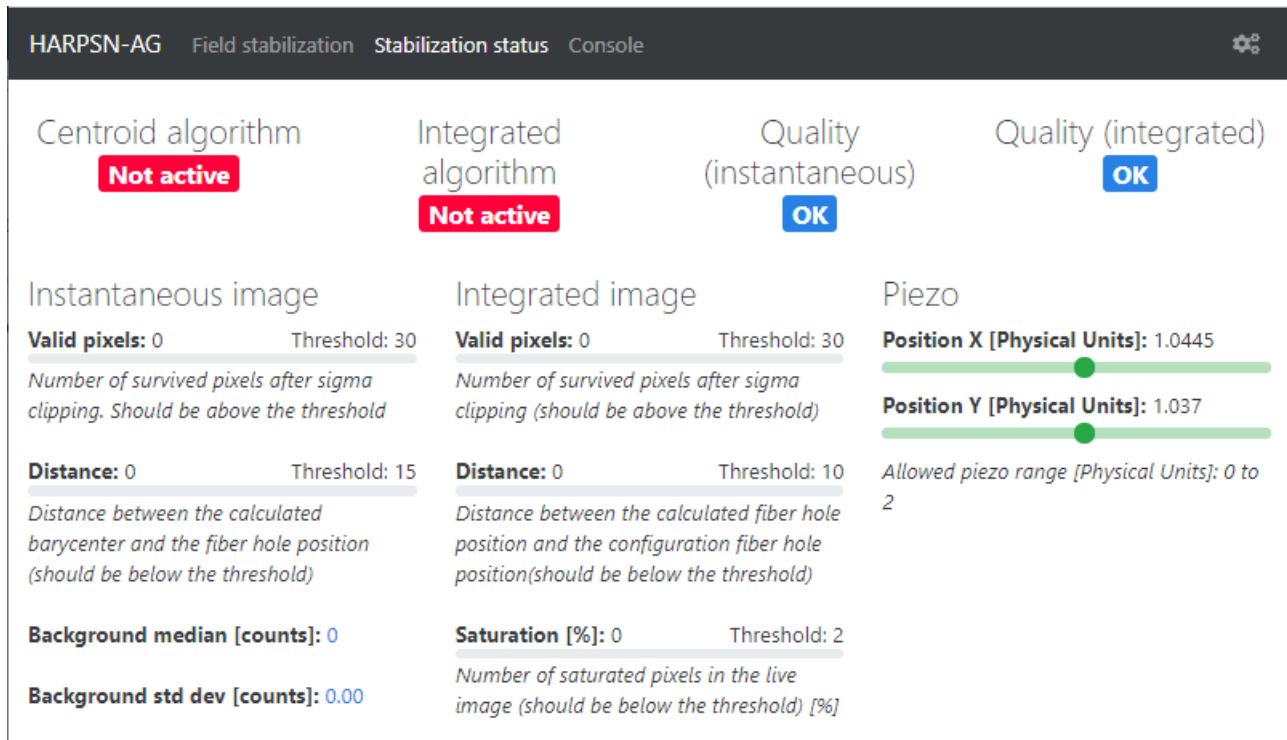*) The error depends by the value set in the Algorithm parameter panel (EN mode)

Figure 14 - Stabilization status panel

2.6.2.4 *Algorithm parameter panel (Engineering mode only)*

This panel is available only for the EN user and has to be used only for engineering operations.

In this panel, the following parameters can be set:

- PID parameters for the correction algorithm
- Thresholds
- Others parameters

For each entry, there is a description of the meaning of the information to be set (Figure 15).

Figure 15 - Algorithm parameter panel

2.6.2.5 Console

In the console are shown the command executed by the AG core and the timestamp associated.

If the command are in green this means that was executed correctly without errors, if in orange means that some warning occurred, if red means that the command has had an error.

Figure 16 - Console Panel

2.6.2.6 Configuration panel (web interface)

This panel (Figure 17) is used to minimize the use of the resources, in case of multiple or remote connections to the AG core with a browser.
With this panel, the user can set independently:

- The reload interval of the monitoring data (in ms)
- The Live image reload (in ms)
- The integrate image reload (in ms)
- The console data reload (in ms)

In this panel are shown also the ip number and the ports of the connection to the AG core.
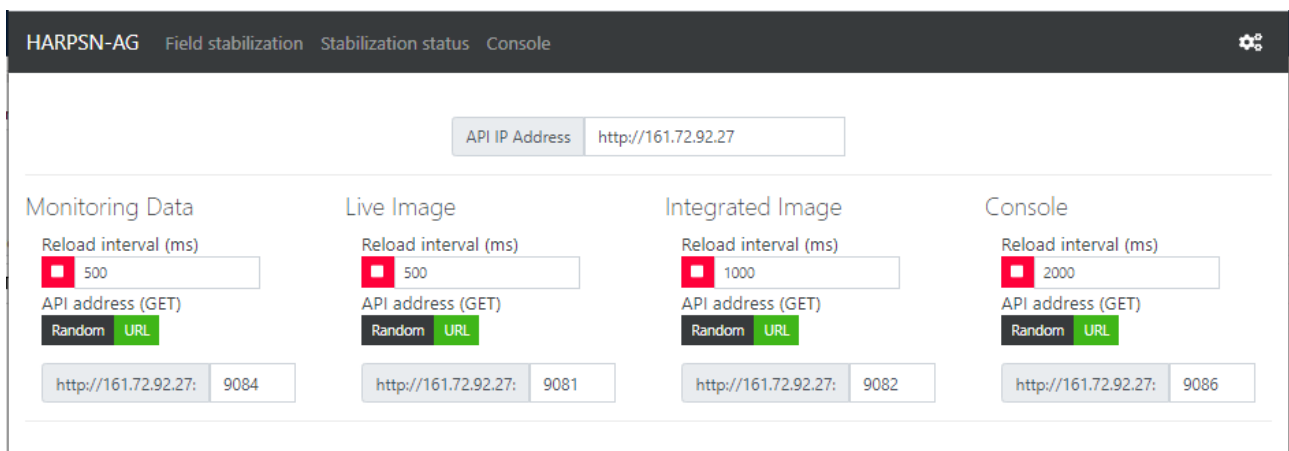

Figure 17 - web interface configuration panel

2.7 Troubleshooting

This part will be completed after analyzing the "Bugzilla" and after receiving the feedback from the telescope operators.

The TO are encouraged to send me any comments and suggestion to revise this manual and, above all, to complete this paragraph.

3 Operations

The previous chapters described the WEB AG panels and, for each panel, the commands and operations that can be used to increase the guide performances.

In principle the autoguide default settings allow the operations without changes but, in rare occasion, the user can had the need to improve the performances due to a conditions.

3.1 Some examples

This paragraph can be completed with the information provided by the TOs that, with their experience in operate with the autoguide in different conditions, can make a valuable contribution to this section.

3.1.1 The star is out of the mask circle
Operations:
1. Stop the Offload
2. Stop the corrections
3. Set piezo to reference
4. Move the star to bring roughly to the fiber center position offsetting the telescope
5. Start the corrections
6. Start the offload

3.1.2 The centroid starts to swing
Operations (to be verified):
1. Stop the correction and the offload
2. Change the exp. Time and the mask if needed
3. Wait until the red bar stops swinging
4. Restart the corrections and the offload

3.1.3 Binary stars (to be verified)
Operations (to be verified):
1. First of all toggle to to **Sequencer Waiting ...**
2. Reduce the mask and set the exposure time to avoid that the companion entries into the mask
3. Wait until the guide works well
4. Toggle to **Auto - No Sequencer Wait**

3.1.4 Manually guide
This option can be used for special observation mode or if the TO deems it necessary.
Operations:
1. Stop the corrections
2. Stop the offload
3. Set piezo to reference value
4. Set the *Move Px* parameter to the needed value
5. Click on the arrows to maintains the star into the fiber position

3.1.5 The guide maintains the star out of the fiber position
This malfunction may be due to an incorrect calculation of the fiber position by the algorithm that compute it from the integrated image (an indication can be a not circular integrated image)
Operations: Set the Fiber mode to Default Ref. Pos

Appendix A - Actions of focus procedure commands

- Start the pointing (move the telescope)
- acquire an image from the autoguider camera and shows the image in the DS9
- Wait for User selects and puts the star in the hole position
- Send the offset to the telescope (repoint)
- Disable the Offload {AG}
- Send a M2 offset (- 0.25)
- Start AG Centroid {AG}
- Disable AG corrections {AG}
- Wait for M2 end movement
- Enable AG corrections {AG}
- start a loop of M2 offsets (0.083) and exposure meter acquisitions (default 7 step)
  At each M2 movement, disable the AG correction while M2 is moving {AG}
- Calculate best focus
- move M2 to best focus
- acquire an image from the autoguider camera and shows the image in the DS9
- wait for user actions (save or cancel focus)
  While the user can execute actions: repoint, expose, get info, etc

Appendix B – List of acronyms (not all this acronyms are used in this document)

ADC	Atmospheric Dispersion Compensator
AG	Auto-Guider
CCD	Charge Coupled Device
CCF	Cross Correlation Function
CFC	Continuous Flow Cryostat
CU	Calibration Unit
DFS	Data Flow System
DRS	Data Reduction Software
E2DS	Extracted 2-Dimensional Spectrum
ETC	Exposure Time Calculator
FEU	Front End Unit
FITS	Flexible Image Transport System
FWHM	*Full Width at Half Maximum*
HARPS-N	High Accuracy Radial velocity Planet Searcher in the North hemisphere
ND	Neutral Density
NSTS	New Short Time Scheduler
OB	Observing Block
RV	Radial Velocity
SA	Support Astronomer
SNR	Signal to Noise Ratio
TBC	To Be Confirmed
TBD	To Be defined
TBF	To be fixed
TCS	Telescope Control System
ThAr	Thorium Argon
TNG	Telescopio Nazionale Galileo
TO	Telescope Operator
VA	Visiting Astronomer